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	Document ID		Kind Codes	Source	Issue Date	Pages
1	US 5945215 A	<input type="checkbox"/>		USPAT	19990831	30
2	US 5912062 A	<input type="checkbox"/>		USPAT	19990615	9
3	US 5885705 A	<input type="checkbox"/>		USPAT	19990323	6
4	US 5876827 A	<input type="checkbox"/>		USPAT	19990302	18
5	US 5871193 A	<input type="checkbox"/>		USPAT	19990216	12

Rung 2:5

```

+-----+
|CPT-    |
+-----+
|Dest     |
|N7:158   |
|-----|
|Expression|
|N7:94 + 2|
|-----|

```

N7:94

```

-CPT- 2:5
-GEQ- 2:2
-GRT- 2:3
-LEQ- 2:4
-LES- 2:1
-MOV- 4:1

```

N7:158

-CPT- 2:5 2:6 2:7

Rung 2:6

```

+-----+
|CPT-    |
+-----+
|COMPUTE  |
|-----|
|Dest     |
|N7:153   |
|-----|
|Expression|
|N7:0 * N7:158|
|-----|

```

F8:0

-CPT- 2:6

N7:152

-CMP- 2:11 2:12

-CPT- 2:6

N7:158

-CPT- 2:5 2:6 2:7

Rung 2:7

```

+-----+
|CPT-    |
+-----+
|COMPUTE  |
|-----|
|Dest     |
|N7:152   |
|-----|
|Expression|
|F8:1 * N7:158|
|-----|

```

F8:1

-CPT- 2:7

N7:152

-CMP- 2:10

-CPT- 2:7

N7:158

-CPT- 2:5 2:6 2:7

Rung 2:8

D:004

06


```

+-----+
|MOV-    |
+-----+
|MOVE    |
|-----|
|Source   |
|N7:95   |
|-----|
|Dest     |
|N7:156   |
|-----|
|-1:      |
|-----|

```

-MOV- 2:8

N7:95

	Document ID		Kind Codes	Source	Issue Date	Pages
6	US 5849804 A	<input type="checkbox"/>		USPAT	19981215	5
7	US 5811040 A	<input type="checkbox"/>		USPAT	19980922	12
8	US 5622765 A	<input type="checkbox"/>		USPAT	19970422	16
9	US 5620797 A	<input type="checkbox"/>		USPAT	19970415	10

12

	Document ID	<input checked="" type="checkbox"/>	Kind Codes	Source	Issue Date	Pages
10	US 5597650 A	<input type="checkbox"/>		USPAT	19970128	6
11	US 5587229 A	<input type="checkbox"/>		USPAT	19961224	15
12	US 5587118 A	<input type="checkbox"/>		USPAT	19961224	6
13	US 5567256 A	<input type="checkbox"/>		USPAT	19961022	5

As best illustrated in FIGS. 3-11, each of the nip rolls 48 extends substantially along the entire adjacent side of the anvil 44. The length of the nip roll is greater than the width of the web. Its ends are journaled in bearings 50. Each of the nip rolls 48 may be pivoted between a first position, such as shown in the left hand side of FIG. 3, where the nip roll is spaced from the adjacent side of the anvil 44 and a second position, such as shown in the right hand side of FIG. 3, where the nip roll presses against the side of the anvil 44. When a nip roll 48 is in its first position, the web may freely run between it and the adjacent side of the anvil. When a nip roll is in its second position, the nip roll serves to hold or clamp the web between it and the adjacent side of the anvil.

Two pneumatic, double acting power cylinders 52 are associated with each nip roll 48, with one power cylinder 52 being connected with each end of the nip roll. More specifically and as best seen in FIGS. 6-9, the rod end of each power cylinder 52 is pivotally connected with a member 55 which, in turn, has one end pivotally connected with the end of the nip roll 48. Each of the other ends of the power cylinders 52 is pivotally connected with a bracket 53 that is mounted on the side members 24. The two power cylinders, connected to the opposite ends of a nip roll 48, can move that nip roll between its first and second positions and urge the nip roll tightly against the adjacent side of the anvil 44 when in its second position.

Two backup bars 54 are mounted, adjacent to their ends, to the other ends of the members 55 for pivotal movement about an axis parallel to the longitudinal axes of the anvil 44 and the nip rolls 48. Like the nip rolls, the backup bars 54 are identical in structure and function, and the same reference numerals are used in describing them.

Each of the backup bars 54 is adapted to move and be pivoted between: a first position, such as shown in the left hand side of FIG. 7, where it is spaced from the adjacent side of the anvil 44 and where it rests on and is supported by roll pins 57 mounted on the side members 24; a second position, such as shown on the right hand side of FIG. 7, and a third position. When in its third position, the backup bar 54 abuts the adjacent side of the anvil 44 and the cutting edge 46 such as shown in the right hand side of FIG. 8. A portion of the backup bar 46 so as to provide a backup or support for a piece of adhesive tape as hereinafter described. When the backup bar 54 is in its first position, the web may freely run between it and the adjacent side of the anvil. Each operator to move the backup bar between its positions. Referring now to FIGS. 3 and 10, a pair of tubular vacuum rolls 58 and 60 are mounted for rotation between the upright members 26. Vacuum roll 58 is mounted for rotation, about a fixed central longitudinal axis. Vacuum roll 60 is, however, movable between a first position, such as shown in FIG. 3, where the periphery of the vacuum roll is spaced from the web W as it passes through the apparatus 22 and a second position, such as shown in FIG. 10, where the web is tightly pressed between periphery of the vacuum roll 60 and the periphery of the vacuum roll 58.

Each end of the vacuum roll 60 is supported by identical assemblies, and only one will be described in detail. More specifically, each end of the vacuum roll 60 is supported, for rotational movement about its central longitudinal axis, at one end of a mounting bar 62. The

by 40 should be made in accordance with the teaching of U.S. Pat. Nos. 3,659,767 and 4,519,858 and should include an inertia compensated festoon assembly comprising a first, upstream inertia compensated festoon having multiple "floating" dancer rollers and a second downstream, inertia compensated festoon having a single "floating" dancer roller. A controlled, driven isolation roller is closely disposed between the first and second festoons. Such festoons function in accordance with the teachings of U.S. Pat. No. 3,659,767 and may be structurally identical to those festoons manufactured by Martin Automatic, Inc. of Rockford, Ill. Such a combined inertia compensated festoon is described in greater detail in co-pending U.S. application, Ser. No. 302,475 that was filed on Jan. 26, 1989, that is assigned to the assignee of this application and that is incorporated herein by reference thereto.

In essence, the assembly 40 functions as an accumulator for the running web. It maintains a constant tension on the running web downstream of the assembly 40 and permits the web to keep running, downstream from the assembly, for a period of time after the web has been stopped upstream from it. The tension set on the web depends on the position of the dancer rollers, vis-a-vis their associated idler rollers. When the running web W exits from the assembly 40, it proceeds to a web processing means, not shown, such as a disposable diaper manufacturing line. The assembly 40, and particularly its preferred form, permits the web W to be run at the aforsaid relatively high speed and under the relatively constant, relatively low tension required for the manufacture of disposable diapers.

As the web roll that is feeding web to the press extruder, the apparatus 20 may be operated to expeditiously join, in a good quality butt splice, the leading end of the new web roll to the trailing end of the expiring web roll so that web can uninterruptedly and continuously be fed to the web processing means. The web from the expiring web roll momentarily stops while the splicing operation takes place. During this brief stoppage, web continues, however, to feed from the festoon assembly 40 to the web processing means so that at all times, web is running, under tension, to and through the processing means. Thus, the splicing operation does not cause any loss of material due to stoppage of the processing means nor any loss of production time.

As best seen in FIGS. 3 and 6-9, an anvil 44 extends from one side of the frame 22 to the other and is secured, at its ends, to the side members 24 midway between their ends. The plane of the anvil is vertical and is perpendicular to the plane of the frame. Its leading or downstream "edge" (in terms of the web flow) defines a cutting edge 46 which is wider than the width of the web. The cutting edge 46 is used to trim or cut the expiring and new webs as explained hereinafter.

The anvil 44 is disposed so that it is adjacent to the path of travel of the running web as it passes through the apparatus 20. The sides of the anvil 44, upstream from the cutting edge 46, are substantially parallel to this path of travel and to each other.

A pivotable nip roll 48 is positioned adjacent to each side of the anvil 44. Each nip roll is adapted to selectively be pressed against the side of the anvil so that a web may be held against the anvil during the splicing operation. The structure and function of the two nip rolls 48 are identical, and thus the same reference numerals are used in describing them.

	Document ID	<input checked="" type="checkbox"/>	Kind Codes	Source	Issue Date	Pages
14	US 5486419 A	<input type="checkbox"/>		USPAT	19960123	16
15	US 5455305 A	<input type="checkbox"/>		USPAT	19951003	8
16	US 5272003 A	<input type="checkbox"/>		USPAT	19931221	11
17	US 5216467 A	<input type="checkbox"/>		USPAT	19930601	11
18	US 5045598 A	<input type="checkbox"/>		USPAT	19910903	3
19	US 5003764 A	<input type="checkbox"/>		USPAT	19910402	7
20	US 4915999 A	<input type="checkbox"/>		USPAT	19900410	9

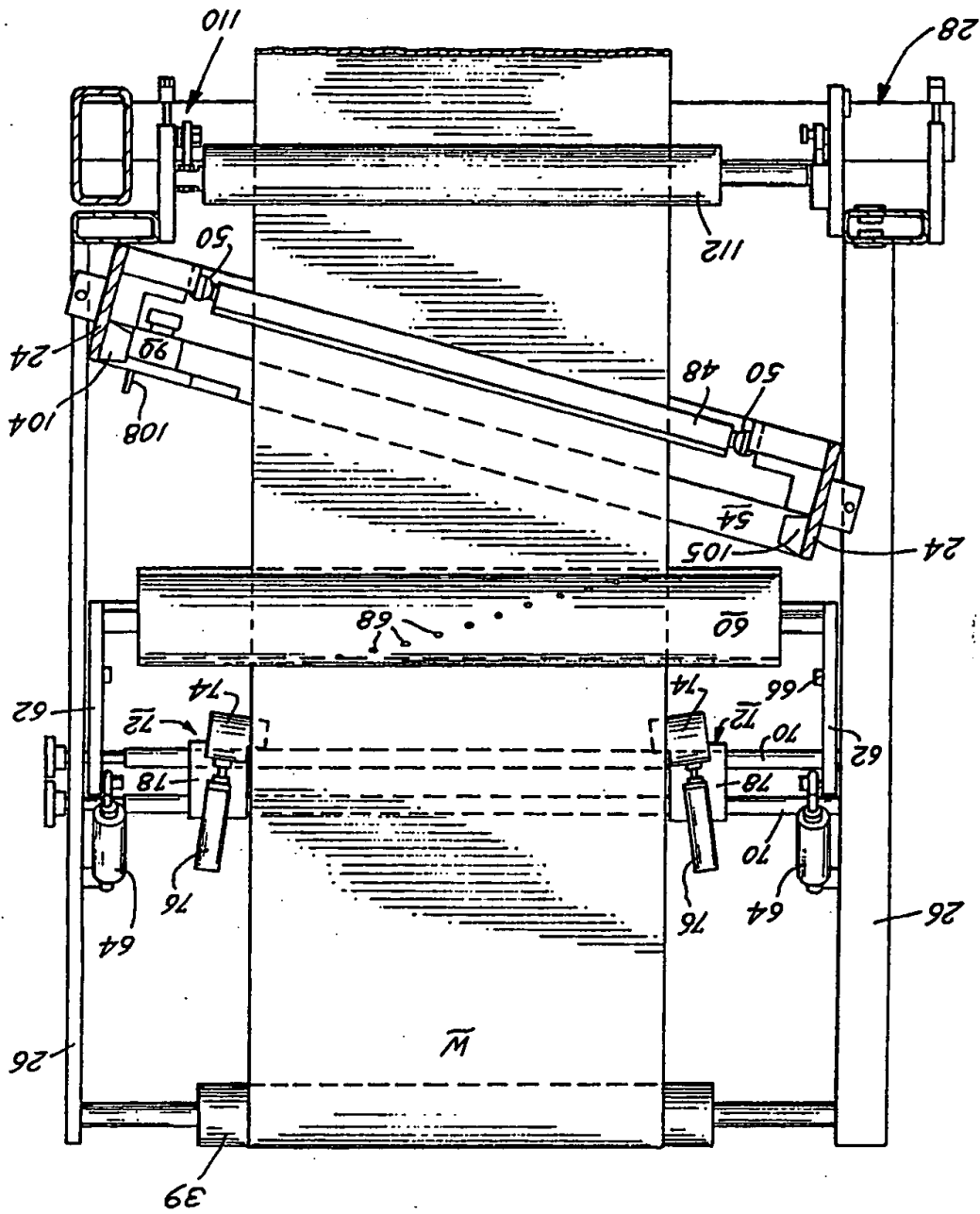



FIG. 11

	Document ID		Kind Codes	Source	Issue Date	Pages
21	US 4871604 A	<input type="checkbox"/>		USPAT	19891003	4
22	US 4797170 A	<input type="checkbox"/>		USPAT	19890110	12
23	US 4617208 A	<input type="checkbox"/>		USPAT	19861014	6

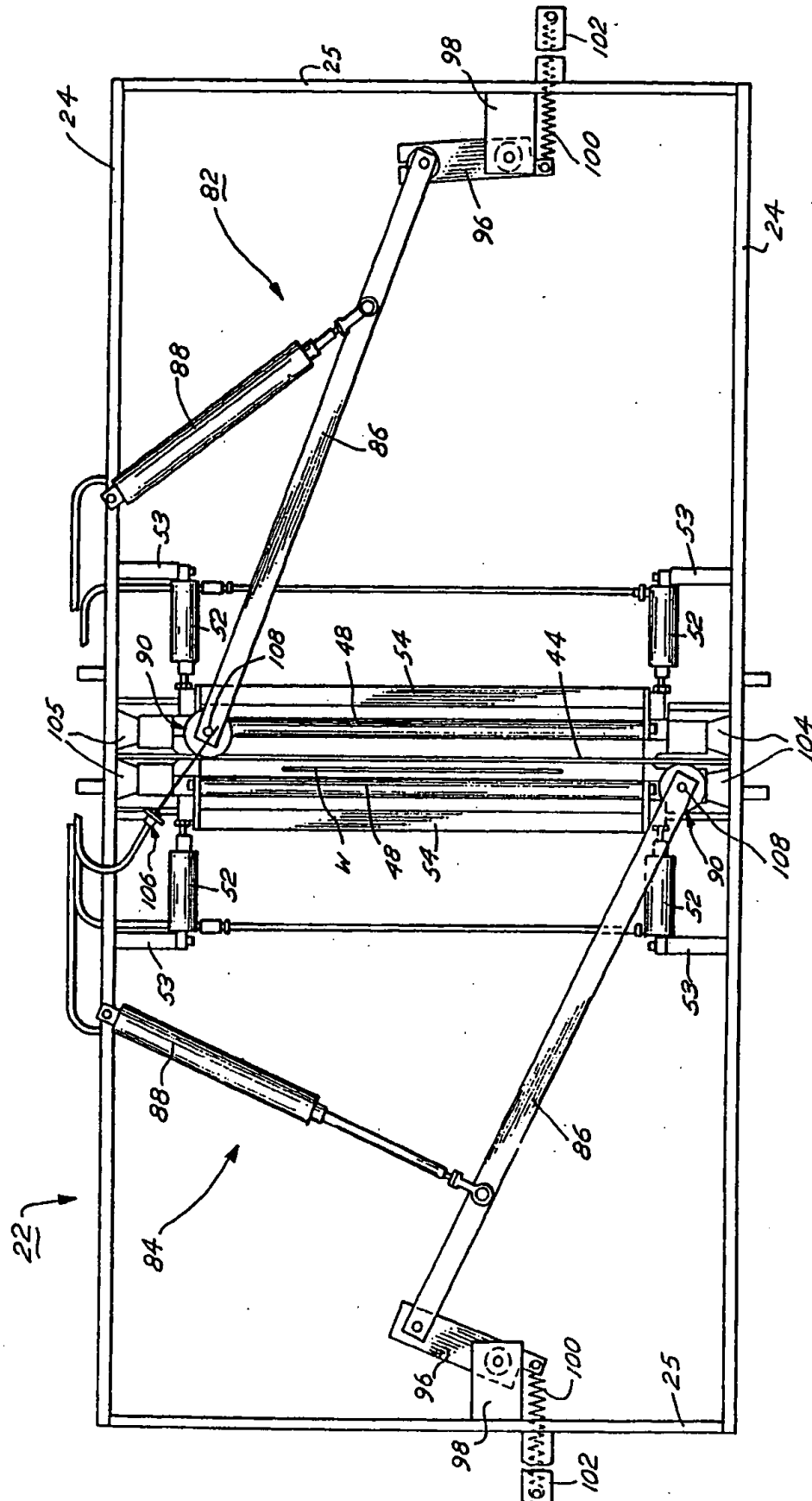

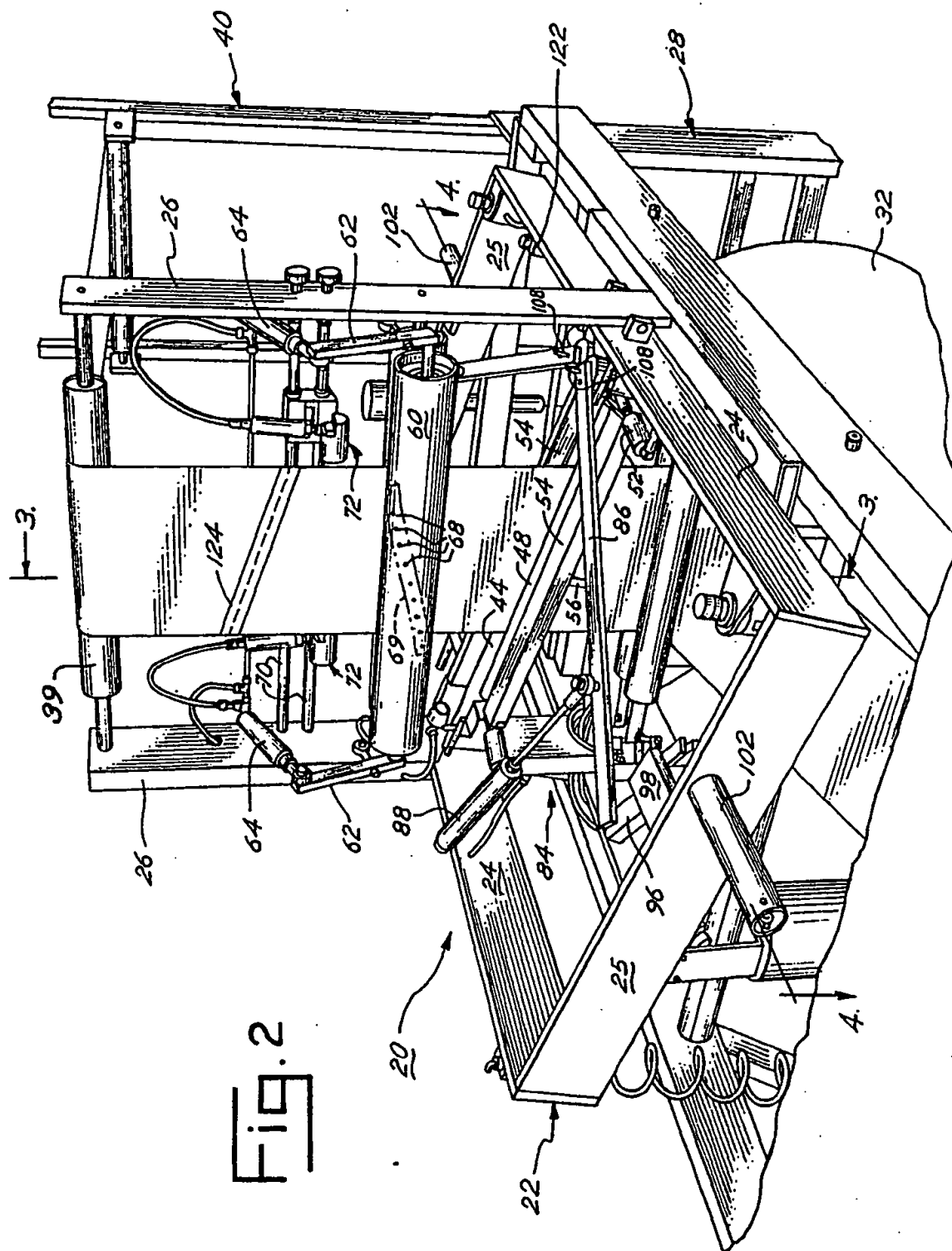


Fig. 5

	Document ID		Kind Codes	Source	Issue Date	Pages
24	US 4557774 A	<input type="checkbox"/>		USPAT	19851210	14
25	US 4307144 A	<input type="checkbox"/>		USPAT	19811222	7
26	US 4010302 A	<input type="checkbox"/>		USPAT	19770301	7
27	US 3839124 A	<input type="checkbox"/>		USPAT	19741001	
28	US 3804699 A	<input type="checkbox"/>		USPAT	19740416	
29	US 3686848 A	<input type="checkbox"/>		USPAT	19720829	



	Document ID	<input checked="" type="checkbox"/>	Kind Codes	Source	Issue Date	Pages
30	US 3680334 A	<input type="checkbox"/>		USPAT	19720801	

	Title	Abstract	Current OR
1	Propylene polymer fibers and yarns		428/364
2	Utilization of waste fibers in laminates		428/140
3	Bicomponent fibers having contaminant-containing core domain and methods of making the same		428/373
4	Pile carpet		428/95
5	Flame resistant, non-conductive hanger		248/317

	Title	Abstract	Current OR
6	Recovery of polyamides from composite articles		521/49.8
7	Process of making fiber for carpet face yarn		264/78
8	Resilient high shrinkage propylene polymer yarn and articles made therefrom		428/97
9	Polypropylene and polyester conjugate carpet face yarn		428/373

Activation of the power cylinder 88 of the assembly 82 causes its knife wheel assembly 90 to move from a first position, as shown in FIG. 4, where the assembly 90 was adjacent to the lower, side member 24 to a second position, as shown in FIG. 5, where the assembly 90 is adjacent to the upper side member 24. Such actuation of the cylinder 88 causes relatively rapid movement of the assembly 90 from its first position to its second position.

The assembly 82 may be returned to its first position, as shown in FIG. 4, from its second position, as shown in FIG. 5, by the operator manually moving the assembly 82. The assembly 84 may be moved between its first and second positions in a similar fashion.

When the assemblies 82 and 84 are in their first positions, as shown in FIG. 4, the rollers 92 about and resilient stops 104 that are secured to the inside of the adjacent side member 24. Similar stops 105 are secured to the inside of the other side member 24, and the rollers 92 about against them when the assemblies are in their second positions.

A conventional whisker valve 106 is mounted on the inside of the upper, side member 24, as illustrated in FIGS. 4 and 5. In each of the assemblies 82 and 84, a vertically disposed pin 108 is mounted on the one end of arm 86 (that is, the end that carries the knife wheel assembly 90) and projects upwardly above the arm 86 and the assembly 90. The "whisker" portion of the valve 106 extends across the path of movement of the assembly 90 and is actuated by the pin 108 when an assembly 82 and 84 is moved to its second position.

As best shown in FIGS. 1, 10 and 11, a conventional drop roll assembly 110 is mounted on the stand 28 immediately below or upstream from the anvil 44. The assembly 110 includes a pair of drop rolls 112 and 114 that are, in turn, connected with their associated, conventional valves 113 and 115, respectively. These drop rolls 112 and 114 serve to direct the web coming from the web rolls 30 and 32 respectively, to a vertical path of travel that extends past the anvil 44 and to the idler roll 39. This assembly 110 is used with a disposable diaper making line.

A butt splice may be performed using the apparatus 20 as follows: When the web processing means is operating, web is being fed from one of the web rolls 30 or 32, for example, web roll 30. This web runs through the apparatus 22, over the idler roll 39, through the festoon assembly 40, and to the web processing means or other web handling device downstream from the assembly 40. While the web is thus running, the normal practice is to mount a new, full web roll, for example web roll 32, on the spindle 34 so that the new web roll 32 will be ready when the "running" roll 30 expires. In anticipation of the actual splicing operation, the leading end of the new web roll 32 is manually brought adjacent to the right side of the anvil 44 as shown in FIGS. 6-9. In this regard, it should be noted that the running web from the web roll 30 is then moving past the left side of the anvil as shown in FIGS. 6-9.

The leading end of the new web, indicated by the reference numeral 116 in FIGS. 6-9, is then trimmed or cut by the knife wheel assembly 90 of the splice wheel arm assembly 82. Before the end 116 is trimmed, the assembly 82 is in its second position, that is, the position shown in FIG. 5 where the assembly 82 is disposed adjacent to the upper, side wall 24. To trim the leading end 116, the assembly 82 is manually moved from its first position, as described above with respect to assembly 82.

After these preparatory steps have been taken, the web on the expiring web roll 30 can be permitted to

	Title	Abstract	Current OR
10	Conjugate carpet face yarn		428/370
11	Resilient, high shrinkage propylene polymer yarn and articles made therefrom		442/195
12	Process for making fiber for a carpet face yarn		264/78
13	Process of making cotton room-size rugs		156/72

DETAILED DESCRIPTION OF THE
PREFERRED EMBODIMENT

improvement of the improved apparatus of the present

A stand 28 supports the frame 22. The frame 22 is

The web rolls 30 and 32 may contain a web of a

ing of two-ply, pressure-sensitive label stock. Idler rollers 35 and 36 and conventional mechanisms

ly be omitted.

A further object of the present invention is to provide

web is cut along the annuli's cutting edge, a part at a time, across the expiring web and beginning at one side

of the expiring web remains under tension ahead of the point of cutting and so that the cut part of the portion of

been restored to its normal position. A related object is to provide an improved method, as described, for form-

A still further object of the present invention is to provide an improved apparatus that is suitable for per-

apparatus, to effect the formation of a good quality butt weld through the use of a running web

These and still other objects, advantages and aspects of the present invention are more fully set forth in the

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front perspective view of a preferred embodiment of apparatus for performing the improved

	Title	Abstract	Current OR
14	Resilient, high shrinkage propylene polymer yarn and articles made therefrom		428/397
15	Propylene polymer yarn and articles made therefrom		525/240
16	Meso triad syndiotactic polypropylene fibers		428/357
17	Brush-based carrier bead removal device for a developer housing in a xerographic apparatus		399/103
18	Slit film yarn based on propylene polymer and its use for the manufacture of synthetic lawn		525/88
19	Nozzle texturizer for yarn manufacturing		57/333
20	Carpet product with integral balancing layer		428/95

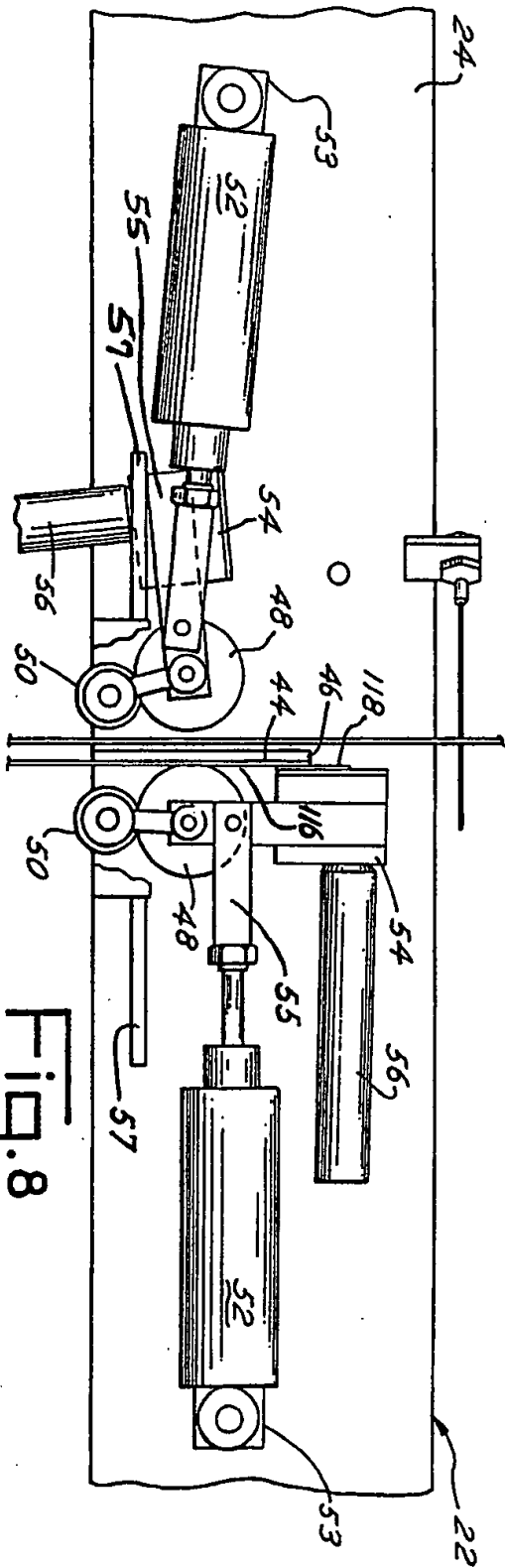


Fig. 8

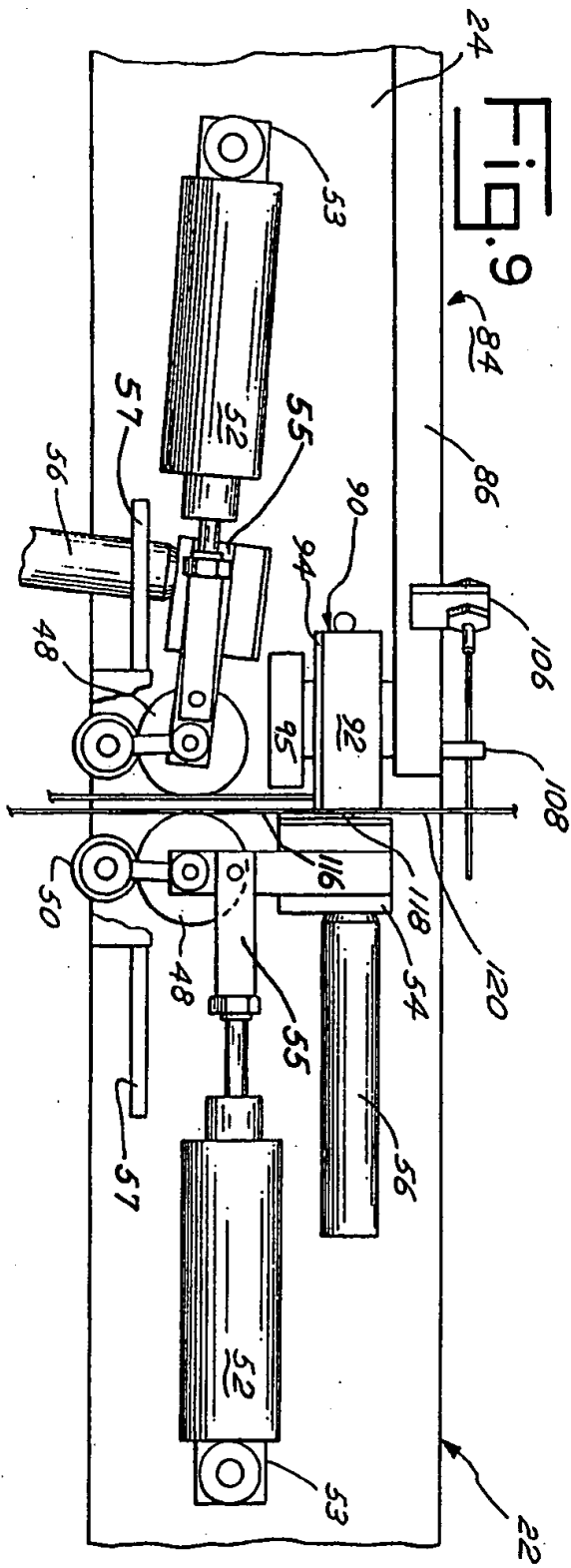


Fig. 9

	Title	Abstract	Current OR
21	Binder powder carpet fiber		428/96
22	System for holding carpet in place without stretching		156/71
23	Non-directional, synthetic, outdoor carpet		428/17

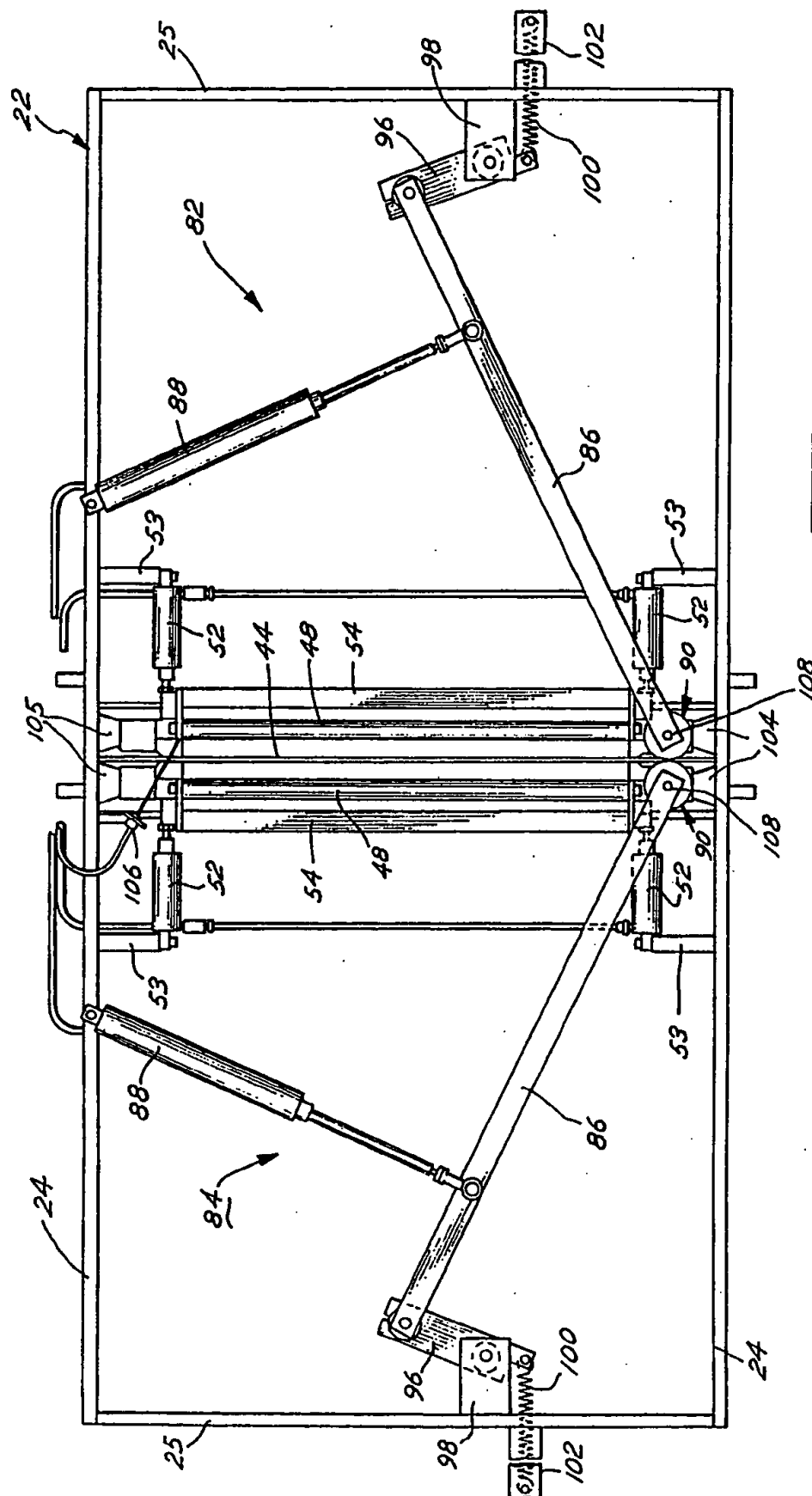


Fig. 4

	Title	Abstract	Current OR
24	System for holding carpet in place without stretching		156/71
25	Static-dissipating fabrics		442/38
26	Tufted face carpet tile		428/95
27	ARTICLE AND METHOD OF MANUFACTURE		156/435
28	SLIP-RESISTANT MAT		428/78
29	HIGHLY RESILIENT POLYPROPYLENE YARN		428/369

	Title	Abstract	Current OR
30	APPARATUS HAVING CHAMBER OF OVAL CROSS-SECTION FOR HEAT TREATING LARGEDENIER TOW		68/5D

[illegible]

The PLC 142 further determines when a splice should be initiated. Given the diameter of the new roll (by an operator input signal), the speed of the motors 126 and 128, and thus the speed of the spindles 33 and 34, the PLC 142 will calculate when the web on the roll will expire and will accordingly initiate a splice in a timely manner.

The PLC may be programmed using conventional 6200 series software (PLC-5 Programming Terminal Software, Release 2.2) of the Allen-Bradley Co. of Milwaukee, Wis. The logic or ladder commands programmed in the PLC 142 are as follows:

```

Rung 2:0
N7:0 S11
]C[ 15 15
+BTW-
+BLOCK TRANSFR WRITE+-(EN)
Rack 01
Group 0--(DN)
Module 01
Control Block N7:0--(EN)
Data file N7:501
Length 37
Continuous N1

```

```

N7:0
-BTW- 2:0
N7:0/15
-]/C- 2:0
S11/15
-]/C- 2:0

```

```

Rung 2:1
LESS
+LESS THAN
Source A N7:94
Source B N7:151
1001
01:005
]C[ 01
00

```

```

N7:94
-CPT- 2:5
-GER- 2:2
-GR1- 2:3
-LEB- 2:4
-LES- 2:1
-MOV- 4:1
N7:151
-LES- 2:1
01:005/00
-]/C- 2:1
-]/C- 2:2
-]/C- 2:1

```

```

01:005/01
-]/C- 2:10 2:14
-]/C- 2:1
-]/C- 2:2

```

```

Rung 2:2
+GEO-
+GTR THAN OR EQUAL+
Source A N7:94
Source B N7:157
1501
01:005
]C[ 01
00

```


[illegible]

previously applied to the leading end of the web from the new roll. Which of the assemblies 82 and 84 does which function in any particular splicing operation depends on the location of the new and expiring web roll on the support stand 28. In other words, the splice wheel arm assembly located immediately above the new web roll will be the assembly used to trim or cut the leading end of the new roll. The other assembly, that is, the one immediately above the expiring web roll, will be then used with the web from the expiring web roll.

The two assemblies 82 and 84 are identical in structure, and accordingly, the same reference numerals are used in describing them. Each includes a splice wheel arm 86. The rod end of a pneumatic single acting power cylinder 88 is pivotally connected with the arm 86 intermediate its ends. The other end of the power cylinder 88 is pivotally connected with the upper one (as shown in FIGS. 4 and 5) of the side members 24. The point of connection between the power cylinder 88 and the side member 24 is approximately one third of the way between the anvil 44 and the adjacent end member 25. A knife wheel assembly 90 is mounted on one end of the arm 86 and is disposed next to the adjacent side of the anvil 44. As best seen in FIGS. 7 and 9, the assembly 90 includes a roller 92 that is disposed, in relation to the anvil 44, so that its lower or upstream edge is positioned just above or downstream from the cutting edge 46 of the anvil. The roller 92 rotates about an axis parallel to the side of the anvil 44.

The bottom or upstream side of the roller 92 constitutes a rotary, round knife or cutting edge, indicated at 94 in FIGS. 7 and 9. This rotary edge 94 is aligned with the cutting edge 46. The plane of the rotary edge 94 is perpendicular to the plane of the side of the anvil 44. The rotary edge 94 rotates with the roller 92 and trims or cuts the web, along the cutting edge 46, when a web is adjacent to its side of the anvil and when the assembly 90 is moved along the cutting edge 46.

As illustrated in FIGS. 7 and 9, the assembly 90 also includes a depending cylindrical bearing member 95 that is carried by the roller 92 below its lower edge. The bearing member 95 rotates about the same axis as the roller 92. The diameter of its outer bearing surface is such that when the roller 92 is positioned as shown in the right hand side of FIG. 7, its bearing surface abuts and is in contact with the adjacent side of the anvil 44. The bearing surface thus holds the web against the side of the anvil while the web is being trimmed. The bearing member 95 also serves to guide the assembly 90 along the anvil 44 during the trimming of the new web. The other end of the arm 86 is connected, for limited pivotal movement, with a bearing block 96. A pivot block 98 is secured to the adjacent end member 25 of the frame 22 and is pivotally connected with the bearing block 96, intermediate its ends, so that the bearing block 96 may pivot about this point of connection. The other end of the bearing block 96 is attached, by a pin, to one end of a coil extension spring 100. The other end of the spring 100 is received within one end of a hollow spring tube 102 and is connected to the other, projecting end of the tube. The spring tube 102 is mounted in a hole in the member 25. The spring 100 exerts a force on the bearing block 96 away from the adjacent end member 25 which, in turn, biases the knife wheel assembly 90 toward the anvil 44.

other end of each of the mounting bars 62 is pivotally connected with the rod end of a pneumatic double acting power cylinder 64. The other end of each of the power cylinders 64 is pivotally connected with its adjacent vertical member 26. An arm 66 is pivotally connected, at one end, with the adjacent member 26 and at its other end, with the member 62 between its ends. Actuation of the two power cylinders 64 causes the members 62 to pivot about the other ends of the arms 66 and thus moves the vacuum roll 60 between its first and second positions.

Each of the vacuum rolls 58 and 60 have a plurality of small holes in its periphery, as indicated at 68 in FIG. 2. These holes 68 are arranged in a spiral pattern from one end of each vacuum roller to the other. The interiors of the vacuum rolls are connected with a source of vacuum by conventional means, not shown. A piece of single sided adhesive tape, shown in phantom line at 69 in FIG. 2, may be laid over the holes 68, with its adhesive side facing radially outwardly, and held on and about the periphery of one of the vacuum rolls by the vacuum prior to and during the splicing operation. The vacuum rolls 58 and 60 and their associated actuating parts and functions may be omitted when the apparatus 20 is being used with a disposable diaper making line.

As best illustrated in FIGS. 2-3, 10 and 11, a pair of metal bars 70 extend between the upright members 26 above or downstream from the vacuum rolls 58 and 60. These bars support two web-side trimming assemblies 72, one adjacent to each side edge of the running web W. The bars 70 are positioned to the side of the path of the travel of the web W and do not interfere with the web as it passes through the apparatus 20.

Each of the two side-web trim assemblies 72 are structurally and functionally the same, and for that reason, the same reference numerals are used in describing them. Each includes a trimmer head 74 that carries a cutting blade adapted to trim any material, like tape, that extends beyond the side edge of the running web W. Each of the trimmer heads 74 is mounted on the rod end of a pneumatic single acting, spring return power cylinder 76. They may be moved between a first position where the trimmer heads are spaced from the running web W and its path of travel and a second position where the trimmer heads are adjacent to the side edges of the web as it runs through the apparatus 20. Actuation of the power cylinders 76 causes the trimmer heads 74 to be moved between their first and second positions. Two bracket block assemblies 78 are slidably mounted on the bars 70. Each serves to mount one of the power cylinders 76 on the bars 70. The trimmer heads 74 and their associated components and functions may be omitted when the apparatus 22 is used with a disposable diaper manufacturing line.

As noted above, the roller 39 is mounted for rotation between the upper ends of the members 26. The path of travel of the web W changes direction as the web passes about the roller 39 from a vertical path, assumed as it passes through the apparatus 20, to a horizontal path as it enters the festoon assembly 40.

Referring now to FIGS. 4 and 5, splice wheel arm assemblies 82 and 84 are shown mounted on the frame 22. During the splicing operation, one of these assemblies 82 or 84 is used to trim or cut the leading edge end of the web from the new roll. The other assembly 84 or 82 is then used to trim or cut the web from the expiring or old roll while simultaneously pressing the trimmed, trailing end of the expiring roll against adhesive tape

[illegible]

METHOD AND APPARATUS FOR FORMING A BUTT SPLICE

This application is a continuation in part of pending U.S. application Ser. No. 153,578, filed Jan. 29, 1988, now U.S. Pat. No. 4,801,342. Application Ser. No. 153,578 is, in turn, a continuation of application Ser. No. 907,117 filed Sept. 12, 1986, now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for joining together a web from a new roll of material to a web from an expiring roll that is being fed to a continuous web processing operation. More particularly, this invention relates to a method and apparatus for joining, by a zero-speed butt splice, the leading end of a new roll of web material to the trailing end of an expiring roll of web material where the web material is continuously processed, at a relatively high speed, through a web processing operation and where the web material, such as the web materials used in making disposable diapers, must be maintained at a relatively constant, relatively low tension because of the nature of the web material.

Disposable diapers are made by combining various webs of materials, one on top of another, in a relatively high speed, continuous manufacturing process. These webs include polyethylene, and various absorbent and hydrophilic inner liners that have different moduli of elasticity and that readily inelastically deform under even low tensions. Disposable diaper manufacturing processes are additionally complicated, from a web handling standpoint, by the inclusion of elastic bands that serve, in the completed diaper, to prevent leakage about the infant's legs.

In the past, the webs were typically processed at a rate of around six hundred feet per minute in disposable diaper manufacturing lines. In an effort to further reduce manufacturing costs, it has now been proposed to process the webs at around eight hundred to one thousand feet per minute. Additionally, new web materials utilized in disposable diapers will require that the webs be run at extremely low tensions, for instance, at one-half to one pound total, on a twenty-inch wide web, or at approximately 0.025 pli (pound per linear inch). The total tension must be held within plus or minus one-quarter pound to avoid inelastic deformation of the web materials.

The maintenance of such relatively low tensions and relatively high processing speed is complicated by the fact that a web must be brought to a complete stop each time a splice is made. At the processing speeds contemplated, this stoppage of the web to accomplish a butt splice must occur relatively frequently. No prior apparatus or methods were known that were capable of handling webs within these specifications, and particularly capable of handling webs of materials utilized in manufacturing disposable diapers.

SUMMARY OF THE INVENTION

In principal aspect, the present invention relates to an improved method for forming an accurate, zero-speed butt splice or joint and to an improved apparatus suitable for expeditiously performing the method while the webs are being continuously processed, downstream of the splicing apparatus, at relatively high speeds and under relatively constant, relatively low tensions. By using the improved method, a web from a new roll of material may be easily, quickly and accurately joined to a web which is from an expiring roll of material and which continues to be run at relatively high speeds, downstream of the roll, under relatively low tension, along a predetermined path of travel that includes a running web storage means, such as a web storage festoon. While a wide variety of materials may be butt-spliced together, the 15 improved method and apparatus of the present invention are especially suited for the splicing of the webs of materials used in the making of disposable diapers. Further, the webs can be run in disposable diaper manufacturing lines at speeds of eight hundred to one thousand feet per minute under tensions of 0.025 pli (that is, one-half to one pound total) on a twenty inch wide web, while zero-speed splices are being made. Because of the significantly increased manufacturing line speed, these butt splices must be made more frequently, and the improved method and apparatus have been able to save a number of diapers per splice that would have otherwise had to be discarded using heretofore conventional splicing apparatus.

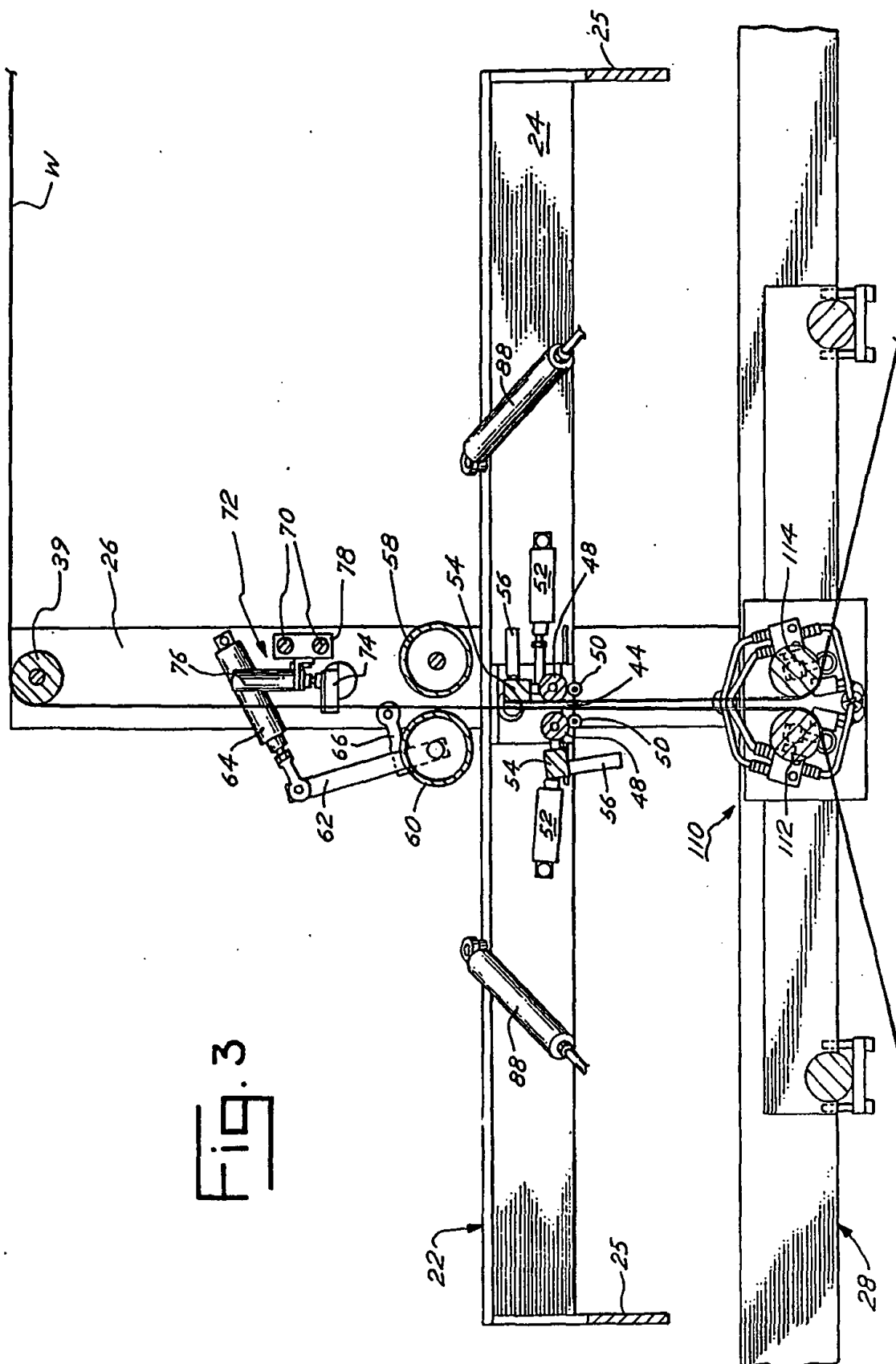
The improved method and apparatus of the present invention afford a number of other important commercial advantages. Minimum operator involvement is required to run the apparatus of the present invention, and thus accomplish a good quality butt splice. As noted, the improved methods and apparatus may utilize a zero-speed splicing concept, that is, the expiring or old web is brought to a stop during the actual splicing of the new web to the expiring web. Nevertheless, due to the short time required to form the butt splice and the use of the running web storage means, the web processing operation can continue at relatively high speeds as material is drawn from the running web storage means during the splicing operation. Thus, the use of the improved method and apparatus enable significantly increased production to be achieved in terms of the overall speed of the disposable diaper manufacturing line.

Accordingly, it is an object of the present invention to provide an improved method for forming a good quality butt splice by holding a portion of the web from the new roll against an anvil that includes a cutting edge disposed at an angle to the path of travel of the expiring web running past the anvil. The portion of the new web is then trimmed or cut along the cutting edge of the anvil so that the trimmed edge of the downstream, leading end of the new web is aligned with and conforms to the anvil's cutting edge. Single-sided adhesive tape is then applied to the leading trimmed end so that a portion of the tape extends downstream beyond the anvil's cutting edge and the trimmed end of the new web. The web from the expiring roll is then momentarily stopped, a portion of that web is held against the anvil; that portion of the expiring web is trimmed or cut along the anvil's cutting edge, and the trailing end of the downstream portion of the tape so that the leading end of the new web and trailing end of the expiring web are secured or joined together by the tape. The joined new and expiring webs are then permitted to run again through the running web storage means and to the web processing operation such as in a disposable diaper manufacturing line.

Another object of the present invention is to provide an improved method, as described, where the portion of the expiring web is trimmed and the trailing end is adhered to the downstream portion of the tape substantially simultaneously. A related object is to provide an

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